

C.) AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

B₁ 1. (Currently Amended) A heat treatment process for restoring the properties of an aircraft engine article having an ~~Inconel 718~~ cast portion comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities and a forged portion that has been subjected to repeated thermal cycles below the δ solvus comprising the steps of:

providing an ~~Inconel 718~~ article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities to be treated;

heating the article in a non-oxidative atmosphere, at a rate to minimize distortion of the article, to a temperature in a range of about ~~1950°F to about 2150°F~~ 975°F to about 1025°F and stabilizing the temperature of the article in this temperature range;

within 60 minutes of stabilizing the article in the temperature range of about 975°F to about 1025°F heating the article to a second temperature in the range of about 1950°F to about 2150°F;

holding the article at a temperature in the range of about 1950°F to about 2150°F for a time sufficient to fully solution precipitates;

cooling the article to a temperature in the range of about 1000°F to about 1200°F in a protective atmosphere at a rate sufficient to maintain dimensional stability while avoiding the formation of δ phase;

cooling the article to room temperature; and
removing the forged portion of the article.

2. (Original) The process as in claim 1, wherein the step of heating further includes a non-oxidative atmosphere is a vacuum having a pressure of about 0.5 micron.

3. (Cancelled)

4. (Currently Amended) The process as in claim 1, wherein the process includes welding the treated cast ~~Inconel 718~~ article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities to new wrought ~~Inconel 718~~ portion article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities after the cooling step, to yield a repaired article.

5. (Original) The process as in claim 4, wherein the process includes heat treating at a temperature in the range of about 1500°F to about 1600°F and holding for a first preselected period, followed by lowering the temperature to a temperature in the range of

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about 1350°F to about 1450°F and holding for a second preselected period, followed by lowering the temperature to a temperature in the range of about 1100°F to about 1200°F and holding for a third preselected period, so as to develop γ' and γ'' , while also relieving welding stresses in the welded article after the step of welding the wrought article to the cast article.

6. (Original) The process as in claim 5, wherein the first preselected period is about one hour, the second preselected period is about eight hours, and the third preselected period is about four hours.

7. (Currently Amended) The process as in claim 1, wherein the process includes welding, after the cooling step, the treated cast ~~Inconel 718~~ article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities to a wrought article, wherein the wrought article is an alloy selected from the group consisting of ~~Waspaloy~~ a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent chromium, about 13.5 percent cobalt, about 4.3 percent molybdenum, about 3 percent titanium, about 1.5 percent aluminum, about 0.08 percent carbon, about 0.006 percent boron, a maximum of about 2 percent iron, a maximum of about 0.15 percent silicon, a maximum of about 0.1 percent manganese, a maximum of about 0.1 percent copper, about 0.05 percent zirconium, balance nickel and impurities and ~~Rene 41~~ a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent chromium, about 11 percent cobalt, about 10 percent molybdenum, about 3.1 percent titanium, about 1.5 percent aluminum, about 0.09 percent carbon, about 0.006 percent boron, a maximum of about 5 percent iron, a maximum of about 0.5 percent silicon, a maximum of about 0.1 percent manganese, balance nickel and impurities, to yield a

repaired article.

8. (Original) The process as in claim 7, wherein the process includes heat treating at a temperature in the range of about 1500°F to about 1600°F and holding for a first preselected period, followed by lowering the temperature to a temperature in the range of about 1250°F to about 1350°F and holding for a second preselected period, followed by lowering the temperature to a temperature in the range of about 1150°F to about 1250°F and holding for a third preselected period, so as to develop γ' and γ'' , while also relieving welding stresses in the welded article after the step of welding the wrought article to the cast article.

9. (Original) The process as in claim 8, wherein the first preselected period is about one hour, the second preselected period is about eight hours, and the third preselected period is about one hour.

10. (Currently Amended) The process as in claim 1, wherein the process includes welding the treated cast ~~Inconel 718~~ article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities to a wrought ~~Inconel 903~~ article comprising a iron-based superalloy having a nominal composition, in weight percent, of about 38 percent nickel, 15 percent cobalt, 0.9 percent aluminum, 1.4 percent titanium, 3 percent niobium, balance iron and impurities after the cooling step, to yield a repaired article.

11. (Original) The process as in claim 7, wherein the process includes heat treating at a temperature in the range of about 1500°F to about 1600°F and holding for a first

preselected period, followed by lowering the temperature to a temperature in the range of about 1250°F to about 1350°F and holding for a second preselected period, followed by lowering the temperature to a temperature in the range of about 1100°F to about 1200°F and holding for a third preselected period, so as to develop γ' and γ'' , while also relieving welding stresses in the welded article after the step of welding the wrought article to the cast article.

12. (Original) The process as in claim 11, wherein the first preselected period is about one hour, the second preselected period is about eight hours, and the third preselected period is about eight hours.

13. (Currently Amended) The process as in claim 12, wherein the process includes welding the treated cast ~~Inconel 718~~ article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities to a wrought ~~Inconel 907~~ article comprising an iron-based superalloy having a nominal composition, in weight percent, of about 38 percent nickel, about 13 percent cobalt, about 4.7 percent niobium, about 1.5 percent titanium, about 0.15 percent silicon, about 0.03 percent aluminum, balance iron and impurities after the cooling step, to yield a repaired article.

14. (Original) The process as in claim 13, wherein the process includes heat treating at a temperature in the range of about 1500°F to about 1600°F and holding for a first preselected period, followed by lowering the temperature to a temperature in the range of about 1400°F to about 1525°F and holding for a second preselected period, followed by lowering the temperature to a temperature in the range of about 1100°F to about 1200°F and holding for a third preselected period, so as to develop γ' and γ'' , while also relieving

welding stresses in the welded article after the step of welding the wrought article to the cast article.

15. (Original) The process as in claim 14, wherein the first preselected period is about one hour, the second preselected period is about sixteen hours, and the third preselected period is about eight hours.

16. (Currently Amended) The process as in claim 1, wherein the process includes welding the treated cast ~~Inconel 718~~ article comprising a nickel-based superalloy having a nominal composition, in weight percent, of about 19 percent iron, about 18 percent chromium, about 5 percent terbium and niobium, about 3 percent molybdenum, about 0.9 percent titanium, about 0.5 percent aluminum, about 0.05 percent carbon, about 0.009 percent boron, a maximum of about 1 weight percent cobalt, a maximum of about 0.35 weight percent manganese, a maximum of about 0.35 weight percent silicon, a maximum of about 0.1 weight percent copper, balance nickel and impurities to a wrought ~~Inconel 909~~ article comprising an iron-based superalloy having a nominal composition, in weight percent, of about 38 percent nickel, about 13 percent cobalt, about 4.7 percent niobium, about 1.5 percent titanium, about 0.4 percent silicon, about 0.03 percent aluminum, about 0.01 percent carbon, balance iron and impurities after the cooling step, to yield a repaired article.

17. (Original) The process as in claim 16, wherein the process includes heat treating at a temperature in the range of about 1500°F to about 1600°F and holding for a first preselected period, followed by lowering the temperature to a temperature in the range of about 1350°F to about 1450°F and holding for a second preselected period, followed by lowering the temperature to a temperature in the range of about 1100°F to about 1200°F and holding for a third preselected period, so as to develop γ' and γ'' , while also relieving welding stresses in the welded article after the step of welding the wrought article to the cast article.

Attorney Docket No. 13DV-13906 (07783-0081)
Serial No. 10/029,365

18. (Original) The process as in claim 17, wherein the first preselected period is about one hour, the second preselected period is about eight hours, and the third preselected period is about four hours.

19. (Cancelled)

20. (Cancelled)

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